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A Smarter Baby Monitor | College of Engineering

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Nov. 2, 2015 – Nate Ruben and Professor of Electrical and Computer Engineering Dr. Jake Gunther can see something on the surface that most people can't. The two are developing a new technology that uses a video camera to detect a person's heartbeat. It's not the first time engineers have tried to remotely measure a heartbeat signal. Medical technology experts have been at it for years with different designs that tether a child or his bedding to an electronic device that alerts parents to the possibility of Sudden Infant Death Syndrome, or SIDS.

But Gunther and Ruben's system is different. Instead of direct contact to an electrical sensor, a video camera is used to capture images of a person's face, neck and cheeks. Though it's invisible to the naked eye, a pumping heart actually changes the colors under your skin.

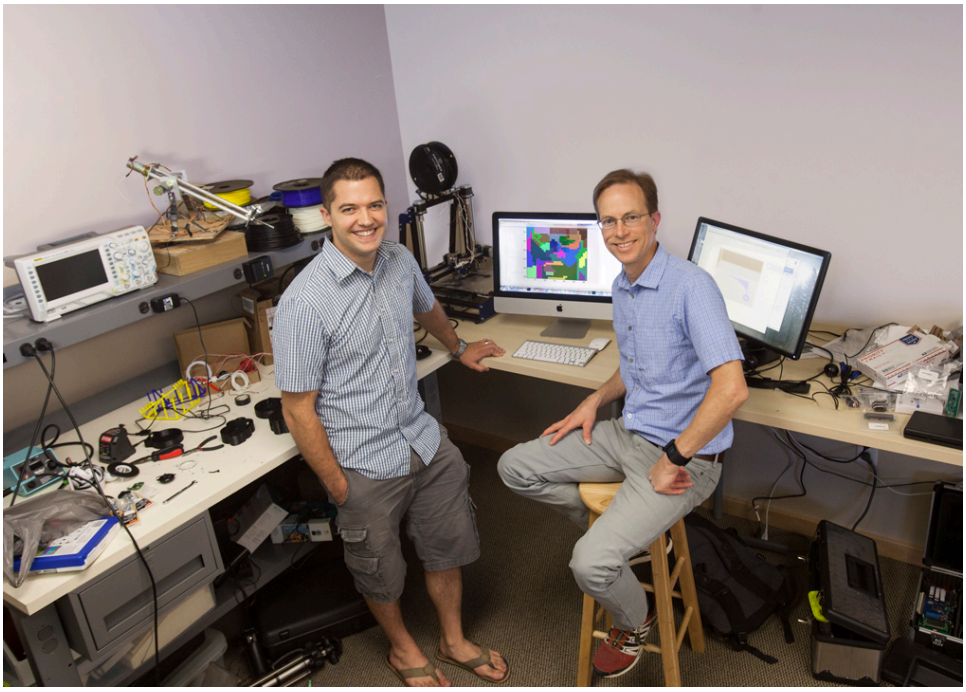
"When your heart beats and circulates blood through your arteries and veins, the color in your skin changes ever so slightly," says Gunther. "You and I don't see it with our eyes and we don't see it through the camera lens either, but our system can detect those subtle differences."

Digital cameras record images in specific values of red, green and blue. One might think the red channel captures the color of blood, and that the blue channel detects hues in our arteries and veins. But that's not the case. Gunther says the system actually uses green values – 256 of them to be precise.

"There is a certain response in the green light that we're looking for," he explained. "We process that color data and take an average over regions of the face, neck or cheek."

It's a simple system, but there's a major obstacle. Sleeping infants don't hold exactly still during sleep, meaning the camera captures a lot of competing signals. Ruben and Gunther, however, say they've developed a way to extract only the signal they need.

"We have a technique that allows us to separate those fine details," said Gunther. "We've done this, we've pulled it off."



This contact-less monitoring system could revolutionize some consumer products like baby monitors, exercise gear and medical equipment. A future version of their design could even replace some hospital tools used to monitor blood pressure and blood oxygenation levels.

“Our system is similar to how a pulse oximeter works,” said Ruben. “But instead of looking at the light coming through the tissue, we’re looking at the light being reflected off a person’s face.”

The idea for the new technology came when Ruben and his wife had their first child in 2012. Like most new mothers, Ruben’s wife consistently checked in on the child as he slept to make sure he was well. All those trips gave Ruben an idea: how to make a better baby monitor. At the time, he and another professor had been experimenting with an app that used simple webcams to show heartbeat, but the technology still had a long way to go. That fall, Ruben built a prototype of his new system and submitted it for his senior design project.